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Procedia - Social and Behavioral Sciences 116 (2014) 333 – 338

Procedia
Social and Behavioral Sciences

5th World Conference on Educational Sciences - WCES 2013

Effects of jigsaw technique on mathematics self-efficacy perceptions of seventh grade primary school students

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Abstract

Cooperative learning is based on the method of instruction that involves students working together in small groups to achieve a specific joint goal. The jigsaw technique, which is one of the cooperative learning techniques where students can work in small groups being responsible for each other's learning and express themselves, is used in this study as well. The purpose of this study is to investigate the effects of use of the jigsaw technique in the 7th Grade "Transformation Geometry" subject on students' mathematics self-efficacy. In line with this purpose, the "Transformation Geometry" subject was taught to 33 students studying in the seventh grade at a primary school located in the Sakarya province of Turkey during four class hours in two stages, the first stage being in jigsaw groups, and the second in main groups. The one-group pre-test-post-test experimental design is used in this study that was conducted quantitatively. Data were collected using the "Mathematics Self-Efficacy Perception Scale". Data obtained were analyzed using statistical methods, and as a result, it was found that there were no significant differences between the pre-test/post-test scores of students. This result shows that the jigsaw technique has no effects on students' mathematics self-efficacy perceptions.

Selection and/or peer-review under responsibility of Academic World Education and Research Center.

Keywords: Jigsaw technique, mathematics self efficacy perception

1. Introduction

Today, students are not expected to memorize or store the information, but rather to know how to reach the information and to have problem-solving skills. Various methods have been developed to improve this approach and make learning more efficient (Tarım & Akdeniz, 2003). As one of these methods, cooperative learning is based on cooperation, a concept that is as old as the human history.

In this context, cooperative learning is defined by Rozmajzl and Alexander (2000) as a method of instruction involving small groups created by students with the skill to cooperate and varying levels of knowledge to achieve a common goal; by Kaptan and Korkmaz (2002) as an interactive learning/teaching method where students study in small mixed groups to achieve their common learning goals at maximum levels; by Açıkgöz (2007) as a process in which students cooperate within small groups to learn by assisting each other's learning; by Bilgin (2006) as a process in which students study in small mixed groups and learn by assisting each other's learning; by Gök (2006)

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Selection and/or peer-review under responsibility of Academic World Education and Research Center.
doi:10.1016/j.sbspro.2014.01.217

as a learning method involving students with varying performance levels to cooperate with each other to achieve a common goal.

Considering all these definitions, the cooperative learning can be defined as a learning approach where students join small mixed groups to achieve a common goal by assisting each other's learning, actively participate in learning activities, and increase their communication, self-confidence, critical thinking, and problem-solving skills (Doymuş, Şimşek & Bayrakçeken, 2004).

Cooperative thinking is widely considered a single method and to have a single application technique. However, there are many different cooperative learning techniques (Namlu, 1999; Açıkgöz, 2007). One of these techniques is the jigsaw technique.

The Jigsaw Technique

The jigsaw technique, which was introduced by Aranson et al (1978) to improve peer cooperation and create team solidarity among students through division of tasks (Sharan, 1980), involves each student in a group to assume learning responsibility. Accordingly, students work in two different groups: main groups and jigsaw groups. First, students come together in their main groups (Doymuş, 2008). The main groups are divided into pieces like a jigsaw puzzle, and students join the jigsaw groups thus formed. These jigsaw groups consist of the group members from different main groups that come together to study the same subject. After learning the subject in a jigsaw group, students return to their main groups and share the information they learned with the members of their own main group (Clarke, 1999).

In this study, the seventh grade transformation geometry subject (attainments: explains reflection, explains rotation movement, draws by rotating the shapes around a point in the plane and at a specified angle) was studied using the jigsaw technique, one of the cooperative learning techniques, and the effects of this technique on students' mathematics self-efficacy perceptions were investigated. In this context, the following problems were identified and answers were sought to the same in this study:

1. What are the mathematics self-efficacy perception scores of seventh grade primary school students prior to application of the jigsaw technique?
2. What are the mathematics self-efficacy perception scores of seventh grade primary school students after application of the jigsaw technique?
3. Is there a significant difference between the pre-test and post-test mathematics self-efficacy perception scores of seventh grade primary school students to whom the jigsaw technique has been applied?

2. Method

2.1. Research Design

The one group pre-test/post-test experimental design is used in this study.

2.2. Working Group

The study was carried out with total of 33 students (16 female and 17 male) studying at a primary school located in the Sakarya province of Turkey.

2.3. Data Collection Tools, Collecting Data and Data Analysis

The "*Mathematics Self-Efficacy Perception Scale*" (MSEPS) developed by Umay (2001) was used to measure students' mathematics self-efficacy perceptions in this study. The Likert-type scale consisted of 14 items, 8 of which were positive (1, 2, 4, 5, 8, 9, 13, 14) and 6 negative (3, 6, 7, 10, 11, 12). The items of the scale were coded as Never (1), Rarely (2), Sometimes (3), Most of the time (4), Always (5). The alpha reliability coefficient of the scale has been calculated to be .88. Cronbach Alpha coefficient related to the inventory has been calculated to be .833 for the data that has been obtained in this study.

The highest score value that could be obtained for this inventory was 70 and the lowest point was 14. The group interval coefficient value was calculated by dividing the difference between the greatest value and the smallest value of the progression of the measurement results by the determined number of groups in the study (Kan, 2009: 407). Therefore, the average arithmetical reference interval, which was calculated as being related to the responses provided by students, was calculated to be (5-1)/5=0.80 in the study.

As the first phase of data collection, students were subjected to a mathematics self-efficacy perception scale prior to the application. Then, the process continued with teaching of the transformation geometry subject for 5-course hours using the jigsaw technique. As the second phase of data collection, the mathematics self-efficacy perception scale was reapplied after the teaching process.

Descriptive statistics methods and independent two samples t-test were applied for the analysis of data. For all of the statistical decoding, .05 significouldce level was taken as the basis. The data were analyzed using the SPSS 15.0 software.

3. Findings and Comments

Findings relating to the problem of *"What are the mathematics self-efficacy perception scores of seventh grade primary school students prior to application of the jigsaw technique?"* and their interpretations are provided below:

Table 1: Students' mathematics self-efficacy perception scores prior to application of the jigsaw technique

Scale Items	$\overline{X}$	ss.	Min.	Max.
I believe I can effectively use mathematics in my daily life.	3,8788	1,05	1	5
I think mathematically while I am planning my day/time.	3,2424	1,35	1	5
I believe that mathematics is not a suitable engagement for me.	3,7576	1,03	1	5
I feel myself sufficient in solving mathematical problems.	3,0606	1,34	1	5
I can solve all kinds of mathematical problems, if I strive sufficiently.	4,4545	0,83	2	5
I always have the feeling that I take wrong steps while solving math problems.	2,9394	1,25	1	5
I get flurried when I encounter an unexpected situation while solving math problems.	2,7273	1,23	1	5
I can make small new discoveries while dealing with mathematical structures and theorems.	2,9394	1,27	1	5
I know what to do when I encounter a new situation in maths.	3,6061	1,09	1	5
I believe that it is impossible for me to have a command of mathematics as much as others do.	3,7879	1,08	1	5
I consider a large portion of the time I spend for solving a math problem a loss.	3,6364	1,59	1	5
I notice that I lose my self-confidence while studying mathematics.	3,6667	1,41	1	5
I can help other people with their problems relating to mathematics easily.	3,1818	1,18	1	5
I can offer solutions to all problems in life with a mathematical approach.	2,7273	1,07	1	5

Table 2: Percentage and frequency values related to average scores prior to study

Average Points Prior to Study									
Between 1.00-1.80 points		Between 1.81-2.60 points		Between 2.61-3.40 points		Between 3.41-4.20 points		Between 4.21-5.00 points	
f	%	f	%	f	5	f	%	f	%
0	0	0	0	7	50	6	42,8	1	7,2

When the Table 1 and Table 2 are examined, it can be seen that all items of the scale has an average score of 2.61 and above. In this context, students responded with "sometimes" for the items 2, 4, 6, 7, 8, 13 and 14, with "most of the time" for the items 1, 3, 9, 10, 11 and 12, and with "always" for the item 5.

Table 3: Percentage and frequency values related to average scores of students

Average Points Prior to Study									
Between 1.00-1.80 points		Between 1.81-2.60 points		Between 2.61-3.40 points		Between 3.41-4.20 points		Between 4.21-5.00 points	
f	%	f	%	f	%	f	%	f	%
0	0	6	18,18	9	27,27	13	39,39	5	15,15

When the Table 3 is examined, it can be seen that none of the students responded with "never". Most of the students (39,39%) responded to the scale with "most of the time".

Findings relating to the problem of *"What are the mathematics self-efficacy perception scores of seventh grade primary school students after application of the jigsaw technique?"* and their interpretations are provided below:

Table 4: Students' mathematics self-efficacy perception scores after application of the jigsaw technique

Scale Items	$\overline{X}$	**ss.**	**Min.**	**Max.**
I believe I can effectively use mathematics in my daily life.	3,7273	1,04	1	5
I think mathematically while I am planning my day/time.	3,2121	1,11	1	5
I believe that mathematics is not a suitable engagement for me.	3,3333	1,36	1	5
I feel myself sufficient in solving mathematical problems.	3,4848	1,06	1	5
I can solve all kinds of mathematical problems, if I strive sufficiently.	4,0000	1,03	2	5
I always have the feeling that I take wrong steps while solving math problems.	2,8788	1,17	1	5
I get flurried when I encounter an unexpected situation while solving math problems.	2,9394	1,22	1	5
I can make small new discoveries while dealing with mathematical structures and theorems.	2,7576	1,15	1	5
I know what to do when I encounter a new situation in maths.	3,4545	1,23	1	5
I believe that it is impossible for me to have a command of mathematics as much as others do.	3,6061	1,41	1	5
I consider a large portion of the time I spend for solving a math problem a loss.	3,4545	1,44	1	5
I notice that I lose my self-confidence while studying mathematics.	3,3030	1,36	1	5
I can help other people with their problems relating to mathematics easily.	3,3030	1,19	1	5
I can offer solutions to all problems in life with a mathematical approach.	3,0606	1,27	1	5

Table 5: Percentage and frequency values related to average scores after study

Average Points of After Study									
Between 1.00-1.80 points		Between 1.81-2.60 points		Between 2.61-3.40 points		Between 3.41-4.20 points		Between 4.21-5.00 points	
f	%	f	%	f	%	f	%	f	%
0	0	0	0	9	64,2	5	35,8	0	0

When the Table 4 and Table 5 are examined, it can be seen that scores for the Item 9 are between 2.61 and 3.40, while those of the Item 5 between 3.41 and 4.20. In this context, it is seen that students responded with "sometimes" to the items 2, 3, 6, 7, 8, 10, 12, 13 and 14, and with "most of the time" to the items 1, 4, 5, 9 and 11.

Table 6: Percentage and frequency values related to average scores of students

Average Scores After Study									
Between 1.00-1.80 points		Between 1.81-2.60 points		Between 2.61-3.40 points		Between 3.41-4.20 points		Between 4.21-5.00 points	
f	%	f	%	f	%	f	%	f	%
1	3.03	4	12.12	12	36.36	11	33.33	5	15.15

When the Table 6 is examined, it can be seen that most of the students (36.36%) obtained a score between 2.61 and 3.40 after the application. In this context, it is seen that students responded with "sometimes" to the scale after the application.

Findings relating to the problem of "*Is there a significant difference between the pre-test and post-test mathematics self-efficacy perception scores of seventh grade primary school students to whom the jigsaw technique has been applied?*" and their interpretations are provided below.

Table 7: Results of the dependent samples t-test of pre-test/post-test mathematics self-efficacy perception scores

	N	$\overline{X}$	ss.	df	t	p
Pre-test	33	47,6061	10,21	32	,641	,544
Post-test	33	46,5152				

When the Table 7 is examined, it can be seen that there is no significant difference between the mathematics self-efficacy perception pre-test/post-test scores of seventh grade primary school students, to whom the jigsaw technique was applied ($t_{32} = .641; p > .05$). The average mathematics self-efficacy perception pre-test score ($\overline{X}$=47,6061) is higher than the average post-test score ($\overline{X}$=46,5152).

4. Conclusion, Discussion and Implications

When the findings of the study are examined, it can be seen that the mathematics self-efficacy perceptions of students prior to the application were significant and high. In their study, Çalışkan, Selçuk and Özcan (2010) studied the effects of prospective Physics teachers' self-efficacy beliefs on classroom levels and their academic achievements. Harurluoğlu and Kaya (2009) aimed to determine the self-efficacy perceptions of prospective Biology teachers towards biology teaching in their study (2009). Analysis of the data showed that self-efficacy perceptions of prospective biology teachers towards biology teaching were high. This study has also shown that the mathematics self-efficacy perceptions of students that participated in the study are high based on the pre-test scores, and this result supports the aforementioned studies.

When the findings of the study obtained after the application are examined, it is seen that there is a drop in students' self-efficacy perceptions, and that the jigsaw technique did not have any effects on the mathematics self-efficacy perceptions. When the literature relating to the cooperative learning is examined, it can be seen that the effects of this method on students' academic achievements and attitudes towards the course (Altıparmak & Nakipoğlu, 2005; Avşar & Alkış, 2007; Karakoyun, 2010), and on the attitude and motivation (Aydın, 2009; Efe, 2011) were investigated. In this context, it is seen the effects of the cooperative learning on mathematics self-efficacy perception were not investigated in the relevant literature. It is considered that this study is different from others in this respect, and that it would provide contributions to the field. Similar studies can be conducted to investigate the effects of cooperative learning on self-efficacy perception.

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